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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

October 29, 1993

HAND DELIVER

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, DC 20554

Dear Mr. Caton:

On behalf of Capital Cities/ABC, Inc., transmitted herewith for filing with the Commission are an original and five copies of its Comments in MM Docket No. 93-177.

If there are any questions in connection with the foregoing, please contact the undersigned.

Sincerely yours,

Roger Goodspeed

RG/ak
Enclosures

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
An Inquiry into the Commission's Policies and Rules regarding AM Radio Service Directional Antenna Performance Verification	))))	MM Docket No. 93-177

COMMENTS OF CAPITAL CITIES/ABC, INC.

Roger Goodspeed
General Attorney, Law & Regulation

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Kenneth J. Brown
Manager, Allocations and Licensing
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October 29, 1993

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An Inquiry into the Commission's Policies and Rules regarding AM Radio Service Directional Antenna Performance Verification	))))	MM Docket No. 93-177

To: The Commission

COMMENTS OF CAPITAL CITIES/ABC, INC.

Capital Cities/ABC, Inc. ("Capital Cities/ABC") submits these Comments and the attached Engineering Statement in response to the Commission's Notice of Inquiry ("Notice"), released June 29, 1993, concerning a general inquiry into the Commission's rules and policies governing performance verification of AM directional antenna systems.

As the operator of nine AM radio stations in major markets (five of which use directional antenna systems) and several national radio networks, Capital Cities/ABC has a strong interest in the competitive effectiveness and quality of AM radio and has actively participated in the Commission's ongoing efforts to remedy the problems facing AM Radio.

As the attached Engineering Statement of Kenneth J. Brown, dated October 28, 1993, sets forth in detail, Capital Cities/ABC believes that (1) verification of directional AM antenna performance is of critical importance to the AM broadcast service because stations are allocated so closely that even a seemingly small deviation from the authorized antenna performance can create substantial interference problems, and (2) a pure theoretical or computer-model approach to proof of performance is inadequate to meet the critical need for accuracy because only on-site measurements can take account of the complex, real-world variations (such as re-radiating objects and unusual topography) that can dramatically alter the predicted directional antenna performance.

Capital Cities/ABC supports the Commission's desire to formulate a set of proposed rules that ensure accurate proofs of AM directional antenna performance without imposing unnecessary and expensive burdens on licensees to make such proofs. While accuracy is of critical importance to the long term viability and quality of the AM service, it is just as important that the new rules not impose such severe financial burdens that accuracy in performance proofs is simply unaffordable by many licensees, a situation that may be occurring under the present rules.

Respectfully submitted,

By: ______________________
Roger Goodspeed
General Attorney, Law & Regulation

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Kenneth J. Brown
Manager, Allocations and Licensing
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October 29, 1993

ABC Broadcast Operations & Engineering 47 West 66 Street New York NY 10023 (212) 887 7777

ENGINEERING STATEMENT OF KENNETH J. BROWN
IN CONNECTION WITH
COMMENTS OF CAPITAL CITIES/ABC, INC.
AM DIRECTIONAL ANTENNA PERFORMANCE VERIFICATION
MM DOCKET 93-177

I am Manager of Allocations and Licensing for the American Broadcasting Companies, Inc., a wholly-owned subsidiary of Capital Cities/ABC, Inc., with offices located in New York City. My education and experience are a matter of record with the Federal Communications Commission.

This statement has been prepared for filing in connection with the Comments of Capital Cities/ABC, Inc., in response to the FCC's Notice of Inquiry (NOI) into AM Directional Antenna Performance Verification (Proof of Performance).

While I can hardly claim to have seen every kind of possible flaw in an AM Proof of Performance, which might show an antenna in adjustment when it is not, in my 25 years in broadcasting (only 17 years since working on my first proof), I have probably seen most of the common ones. I have several concerns, both with the way antenna performance verifications are now carried out, and with any proposals to utilize too much theoretical calculation and not enough measurement. I believe a realistic answer should be somewhere in between.

Types of instrumentation at the station.

The antenna monitor is a useful piece of apparatus, but it is only as good as the data it receives from the sample system. It is quite useful to know accurately the relative electrical lengths of the sample lines, so the differential between real parameters at the samplers and as read on the monitor can be calculated. It would be useful to have documented which mode of a symmetrical array is being sought in adjustment, to avoid future engineers from having to guess or re-derive. If toroid samplers are to be used in an array, the relationship between loop parameters and base parameters must be a simple one for all the towers, since more complex structures are capable of rendering surprises. For towers above 120 degrees tall, toroid samplers may not provide a proportional indication of the vector field being created by the tower. If loop samplers are to be used, they must be located as near the current point as possible, and again surprises are possible from complex structures which can lose the anticipated relationship between theoretical and measured parameters. For example, a tower top-loaded utilizing guy wire sections can have current point and radiation characteristics significantly different from what would be expected from sinusoidal current distribution theory. When differing radiating structures are used within the same array, such as a mixture of tower shapes and sizes, difficulties in relating measured parameters to theoretical parameters increase, thus requiring greater reliance on field verification of the antenna pattern adjustment.

The stability of a directional antenna array depends on both design and installation. Some pattern designs are much more sensitive to parameter variation than others. Also, the design of the feed system determines that some parameter variations with respect to others are more or less unlikely, and worst case pattern outages depend on worst case combinations of parameter variations occurring. Also, both the condition of the ground system and the number and condition of items crossing an insulated tower base can have major stability effects. For all these reasons, I suggest that parameters should hold, during the measurement program, within 1% ratio and 1 degree phase, as nearly as this can be determined on the antenna monitor. If parameters do not hold very stably during the measurement period, it bodes ill for the pattern holding stable over the longer term. Critical arrays should hold tighter tolerances, or one can never be really sure what pattern is being measured. The instrumentation should be examined at least at beginning and end of the field measurement period each day, to be sure the pattern is correct and stays correct during the measurement period. It is also wise to be sure that at least one check is done near midday, presuming that begining and ending checks will fall in early morning and late afternoon, to see if there are any unusual effects with midday heat. It would also be well to check for parameter shift with rain. While it should not be necessary to submit these data to the FCC, these readings should be maintained during the normal log retention periods available for inspection or challenge if necessary, and the stability of the readings should be certified to the FCC as part of the proof documentation.

Monitor points not only provide a useful check on the integrity of the sample system, but provide the basis for antenna parameters at variance.

Field measurements for pattern verification.

There are several important items of information which are not available from an antenna sampling system. For example, an in-line directional array should produce a pattern which is symmetrical about the line of towers. Measuring one side of the pattern should completely define the other side of the pattern, except for four factors. One is the accuracy of the direction of the actual line of towers -- surveyors have been known to make mistakes, especially in correcting for magnetic declination. The second is the straightness of the line of towers -- is it really adequately straight or is there some dogleg to the array? Third is the possible presence of reradiating objects near enough to become effectively part of the antenna system. Fourth is the presence of objects in the environment, such as reradiating objects far enough from the array to only produce a local effect, which nonetheless disturb the accuracy of measurements in their vicinity. Any of the first three could disturb the symmetry of the pattern, while the fourth can give the appearance of it. Were there any way to eliminate the first three points from consideration in a particular case, it would be possible to adequately characterize the pattern by measuring only one side of the in-line array.

Another thing the sample system cannot measure is power delivered to the phasing and coupling system and total power delivered to the towers. The common point meter and impedance bridge do not characterize losses in the antenna system. Measurement of base current and Operating Impedance Bridge (OIB) measurement of base impedance (real part - resistance) at each tower, assuming there is a series output element in each network which is adjusted to exactly restore operating parameters (thus cancelling the effect of the reactance of the bridge), could be used to determine the total power delivered to all towers in operating mode (adding a negative tower's power negatively), and hence the losses in the phasing and coupling system and transmission lines, but it would not include any ground system losses or tower problems which can also reduce RMS. This measurement can, however, provide a useful check on pattern RMS, at least for problems coming from some of the most common sources. For shared tower systems, of course, this measurement must most likely be made with the other station(s) off the air.

Nondirectional measurements in an RF Proof are supposed to serve two purposes. The close-in measurements on a radial are supposed to determine or confirm the nondirectional inverse distance field (IDF), so the far-out measurements can become references for directional measurements at the same points. Soil conductivity is also determined or confirmed in this process and may be used for allocations purposes. The problem with this process is that it is difficult or impossible to tell from analysis alone, with insufficient close-in measurements, whether a non-d radial shows an IDF differing from theoretical because of reradiators in the vicinity (such as lack of detuning of other towers in the array). As matters stand, it is at once an incredible nuisance to obtain the close-in measurements and too easy to err by obtaining too few.

I propose that most close-in nondirectional measurements should be made strictly optional on a proof, that instead the nondirectional pattern should be presumed to be circular and of the theoretical RMS of the nondirectional antenna. Antenna tuning and coupling system losses do not affect the non-d IDF since power is measured at the tower base. Other towers in the array should be isolated during non-directional operation, since it is usually much easier to do that anyway (with the possible exception of shared antenna systems) than it is to make adequate close-in nondirectional measurements on every measured radial. Close-in measurements on one radial should be used to support the theoretical non-d efficiency. The close-in radial should be chosen to avoid potential re-radiators as much as possible without aiming so much into any nearby undeveloped land as to require jungle skills to obtain a significant number of measurements. This radial need not coincide with any other measured radial and need only be 2-3 km long to fulfill its purpose, so long as there are at least 10 points within the km closest to the station and another 5 points thereafter. This process would result in non-round non-d reference patterns being the exception rather than the norm, eliminate much of the grungiest work involved in proof measurements, and even make it unnecessary to draw the reference non-d pattern in most cases. In event there really is a problem on a radial leading to a non-circular reference pattern, the question should be asked, what is the cause? Is there a re-radiator which could become part of the directional array?

Radials need to be measured to determine every pattern feature; the location and depth of every (nonsymmetrical) null and the location and size of every (nonsymmetrical) lobe. A null which is misplaced but too deep will affect the sizes of the adjacent lobes. On the major lobe(s), I see radials off to the side of the lobe as being more a check of front null placement than of pattern RMS. RMS can be checked by one radial in the center of each main lobe and the OIB/base current measurements discussed above for many arrays. I see no need for more radials than are needed to define pattern features and to show symmetry on in-line arrays. A two-tower array, for example, could be shown in adjustment with not over 5 radials, since there are only four field variables (relative field, phase, RMS, and nearby re-radiator -- ground system or tower losses should show up in RMS, and tower discontinuity should impact tower base impedance).

I also have serious questions about the need to extend measurements to 20 miles (34 km) from the antenna system. The farthest-out measurements show diminishing returns in terms of data usefulness due to soil conductivity effects and low signal levels, while at the same time requiring increasing travel time to get to the measurement locations. It is interesting that Rule 73.154b requires measurements to be made "within 2 to 10 miles (3 to 16 kilometers)" of the array, while Rule 73.186a1 allows that measurements made within "10 times the spacing between the elements of a directional antenna" are not appropriate since "a broadcast antenna is not a point source of radiation". For radials broadside to a large, low-frequency, wide-spaced multi-tower array, "10 times the spacing" between the farthest-spaced elements can be considerably more than 2 miles or 3 km before the pattern is fully formed. For the typical array, I believe that at least 15 measurements between 2 to 10 miles (3 to 16 km) will provide excellent assurance of array adjustment. For the large array, measurements should go farther out to get at least 15 good measurements since they should start farther out. For an array located near a large body of water, measurements should be made where and as documentable locations are available. There are other unusual situations also, which can require some exercise of engineering judgement; I am familiar with one station which has a power line extending directly out the first ten miles of a radial and affecting all field readings over that segment, but good data are available beyond that point where the power line turns away. One can't get good data across a bay or Manhattan Island, NY. Exceptions to preferred distances should be made as necessary to gather a sufficiency of good data points, within the bounds of signal attenuation and site accessibility, so long as the cause is documented for Commission review, and the partial proof should duplicate at least ten of the still-valid full proof directional points.

The above discussion assumes that proof-of-performance measurements are intended for the purpose of verifying the adjustment of a directional antenna system, not for allocation purposes. Allocation measurements generally must go much farther, but on fewer radials. Also, confirmation of station operating parameters is often not available during the making of allocation measurements, so it is necessary to obtain enough measurements to verify the station is operating normally. The monitor points of daytime directionals should be checked. Further, reference should be made to the latest proof to determine the IDF on which to base conductivities, and leeway allowed for the difference between measured and standard patterns. Indeed, if the Commission were to routinely utilize proof measurements to check allocation measurements, I believe some anomalies would surface; a station could be allocated on measurements showing low conductivity, but the coverage determination based on the subsequent proof could show high conductivity. For later allocation measurements, the conductivity could magically come down again, only to go back up to show good coverage when the revised array were proven.

To deal briefly with two minor points, I believe copies of maps of the measurement points should continue to be filed with the Commission, not only to allow the Commission staff to check details of the measurements, but since these items can disappear from station files after enough time has passed, and Commission files may be the only sure way to reconstruct a valuable reference. Secondly, a bridge run of the antenna or common point impedance across the transmitted bandwidth is an extremely valuable resource for determining bandpass characteristics, but only for +/- 15 kHz from carrier.

Use of theoretical parameters in place of measured?

One thing I keep hearing about in recent years is the wonderful utility of the Numerical Electromagnetics Code. One thing I believe we have learned in this company is the ease with which NEC can give wonderfully wrong answers. Reference is made to the Comments of Capital Cities/ABC, Inc. on Section IV (Antenna Systems) in MM Docket 87-267, dated June 21, 1988, and the Erratum, dated June 23, 1988. In these documents, statements of two recognized experts in Method-of-Moments codes and analyses (not CC/ABC employees) were presented. These statements emphasized cautions concerning verification of program code results against measured data for unusual situations, limitations of different codes in modeling differing complex conditions, and difficulties in modelling certain kinds of structures to obtain even remotely reasonable results. A common thread connecting those statements and our experiences is that it is very easy for an inexperienced modeller (or even an experienced one) to obtain very wrong results in a number of ways. The NEC is an excellent tool but, like any tool, it has its limitations and it can be misused, even in ways not apparent to a careful user. It is anything but foolproof. For these reasons, method-of-moments codes are useful to support measurements but not to replace them, no matter how much we dislike making and analyzing field measurements.

Reradiating structures.

I see no difficulty in the principle, only in the execution. A reradiating structure will either produce only a local effect, in its immediate vicinity, or it will in essence become a part of the antenna system and impact the entire pattern. If only a local effect is produced, this should be apparent as a "bump" in the field readings, and the structure should be ignored or detuned as appropriate. The vertical pattern only matters for nighttime operation, for skywave protection. If a reradiator only impacts a day pattern, then it can be detuned or the array adjustment offset to correct for it. If it affects a night pattern, then it can be detuned to have minimal effect, or it can be modelled as a part of the antenna system, its impact on vertical angle protections calculated, and the design of the complete antenna system adjusted to include the effect of the unintended element. The resulting adjustment would then be put on the antenna system and proven in the horizontal plane as usual.

DATED: October 28, 1993

Kenneth J. Brown
Kenneth J. Brown